

# PSYCHE.

## FRAGMENTS OF THE COARSER ANATOMY OF DIURNAL LEPIDOPTERA.

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### 6. THE LARVA OF *HAMADRYAS IO*, OF EUROPE.

(Continued from p. 275.)

*Nervous system.* The cephalic lobes are vertically subpyriform, the apex downward. The third and fourth body-ganglia are almost as near each other as the third is to the origin of the nerves which spring from the cord in advance of the third ganglion, and the two ribbons which connect them are a very little parted.

*Glandular system.* Each of the silk-vessels is formed of an initial thread, 0.05 mm. in diameter, which is about one-seventh of the entire length, and a cylindrical tube, of four times the size of the thread; this terminates abruptly in a pointed tip, from which a delicate thread trails, and this thread is attached to the under part of the sides of the front of the intestine; the whole has a slightly wavy course, running at first near its mate on the under side of the body, as far as the second abdominal segment; then, turning abruptly and a little upward to above the middle of the body, it continues its former direction.

*Male generative organs.* The testes are situated in the middle of the dorsum of the fifth abdominal segment, as in *Danaïs*; they have only a slight rosy tinge across the middle, are 1.5 mm. long by half that width, and are subreniform in shape.

*Female generative organs.* The ovaries in the female are situated in the same place as the testes in the male, and consist of a pair of long obovate sacs, 2 mm. long and about 0.5 mm. broad, bluntly rounded at each end, vertically disposed, approximated, but with the lower end curved outward; they are white, and each consists of a bundle of similar tubes.

*Rudiments of wings.* Each of the wing-pads in the full-grown larva is formed of a pellucid, compressed, rounded, nearly hemispherical sac, fully 2 mm. long and a little longer than broad, abundantly permeated by white branching threads which do not seem to extend into the very base of the wing-pads; they are situated, base downward and convexity outward, just above and scarcely in advance of the base of the tracheae of the third thoracic segment, and at a corresponding position on the second segment; the membrane is slightly opaque and granulated; the permeating vessels are composed of bunches of numerous, minute and perfectly equal threads, varying in length and in number; they appear to be hollow and are 0.0025 mm. in diameter. A figure will be found in my work on Butterflies, already cited, p. 95.

7. THE PUPA OF *HAMADRYAS IO*, OF EUROPE.

*Muscular system.* In general the muscles of the abdomen seem to be situated much as in the larva, but are more compact and almost or altogether longitudinal, the oblique muscles disappearing. Those of the under surface of the abdomen consist, on each side of the body, of a ribbon, one millimetre broad, composed of two contiguous strips, the outer slightly the broader, running next the integument through the entire length of the abdomen, the inner edge at one millimetre's distance from the nervous cord.

*Digestive system.* The oesophagus is a slender, thread-like tube, less than 0.1 mm. in diameter; as it enters the abdomen it is at once directed upward and suddenly expands into a small bulbous muscular crop, the upper part of which opens into the reservoir, a subfusiform blind sac, broadly rounded at tip, 1.5 mm. in breadth and 5 mm. long, reaching the extremity of the fourth abdominal segment: immediately on the apical contraction of the crop, the stomach arises; this is at once many times broader than the crop, and remains nearly of this size, to the tip of the fourth abdominal segment (or where the reservoir ends); from this point on it is only half its former diameter and extends as a straight tube to the middle of the fifth abdominal segment. On each side, at the base, the stomach bears some rounded lobes, nearly as large as the crop, and besides these, arranged in a row down each side of the median line, it is profusely covered with small pea-like

pockets. The intestine is tortuous, of considerable length, 0.15–0.18 mm. in diameter, and ends in the colon, a bladder-like sac, pyriform in shape and about 0.8 mm. long, containing a whitish substance: this opens into the rectum, a broad and straight tube, 1.5 mm. long and 0.25 mm. broad.

The salivary glands are composed of threads about 35 mm. long, and of a uniform size throughout; they first run straight beside the slender oesophagus, until near the middle of the mesothorax, when they become very strongly crinkled, forming by their convolutions a fusiform mass, 3.25 mm. long and 0.5 mm. broad, continuing in the same course to the middle of the metathorax.

The malpighian vessels arise at the extremity of the smaller part of the stomach, without the intervention of any basal sac, three branches arising together at the a very short distance from the base of their common stem and parting from it at right angles.

*Respiratory system.* The tracheae seem to be much as in the larva, only greatly reduced in size, very delicate, not at all opaque, and not divided into two sorts; the lateral longitudinal canal of the abdomen appears to be larger than any of the other vessels.

*Circulatory system.* The dorsal vessel is a slender, equal canal, terminating abruptly behind at the tip of the fourth abdominal segment, lying next the integument of the future imago and about 0.15 mm. in diameter in the abdomen; as it enters the thorax from behind it

plunges downward to just above the oesophagus in advance of the crop, then passes rapidly upward again to the integument, which it follows to the middle of the mesothorax, diminished to half its former size, so as to appear a mere thread, and then, casting free again, passes forward as in the larva, reaching the oesophagus again in the prothorax, where it appears to be attached to something, which was not made out; beyond this point it was not traced.

*Nervous system.* Between the cephalic and thoracic ganglia the nervous cord is moderately broad, flattened and double; the thoracic ganglion is situated in the front part of the mesothorax; it is oval and evidently composed of two unequal, anterior and posterior, elements, for slightly in front of the middle it is pierced by a vertical passage of considerable size, and the portion in front of it has a slight, independent tumidity; the whole is a little more than 1.5 mm. long and less than half as broad, tapering posteriorly; from near the middle it emits lateral nerves, which pass toward the wings, and just before the hinder end a rather prominent nerve, which runs backward, parallel to the main cord and nearly as large as it, half way to the abdomen, evidently feeding the legs; besides these there is another similar pair, also running backward but divaricating a little, which originates from the widest part of the posterior portion. The cord itself is rather slender, and runs without enlarging until it reaches the abdomen, when it *appears* gradually to thicken and form a pseudoganglion of an elongate, fusiform shape, nearly 1.5 mm. long and terminating just before

the first abdominal ganglion; this appearance, however, is produced by the fact that throughout the abdomen the cord is overlaid by an investment mainly pellucid, but not pellucid enough to allow the true cord to be seen, excepting from beneath; this investment does not cover the ganglia to an equal extent, but only as a film; so that the abdominal development of the nervous system is an exceedingly delicate cord, expanding at four different points into lenticular, disk-like ganglia of a small size, but many times exceeding the cord in diameter, the whole enwrapped in a semi-pellucid investment which makes it appear of nearly uniform diameter, excepting in front of the first true abdominal ganglion, where the investment becomes swollen and less pellucid, resembling a greatly elongated ganglion. The abdominal ganglia are 2.25 mm. apart; the first, which is scarcely broader than the cord, and noticeable mainly by its whitish color, is situated near the end of the second segment; the second at the beginning of the fourth; the third at the beginning of the fifth, and the last in the middle of the sixth segment; the last is larger than the others and emits four delicate posterior nerves; each of the abdominal ganglia is also provided with lateral nerves, similar to, but more delicate than, those of the larva.

In Newport's observations on the changes in the nervous cord of *Aglais urticae*,\* he shows a more considerable change between forty-eight and fifty-eight hours than perhaps between any others of the stages he has drawn and

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\*Phil. trans., 1834, p. 412-416, pl. 15-16.

described, which are successively (after the pupal state is assumed) 1, 13, 18, 24, 36, 48, and 58 hours. According to his account the second and third (original) ganglia at this period "approach and coalesce, and the double ganglion thus formed is only separated from the larger thoracic mass, composed of the fourth and fifth ganglia, and part of the sixth, by very short but much enlarged cords." As the figures given by him do not in themselves show how this amalgamation of the second and third ganglia is effected, I examined the nervous cord of the present species, *Hamadryas io*, 48, 51 and 55 hours after pupation, with the following results: The pupa of 48 hour's age differs from that of *Aglais urticae* only in the separation of the fourth ganglion from the united fifth and sixth; very short and broad ribbons connected them, but they were unmistakably separated by half the width of the fourth ganglion; while the third and fourth ganglia were separated by about the diameter of the latter ganglion. At 51 hours the condition was more as

represented by Newport at 48 hours in *A. urticae*, the fourth, fifth and sixth ganglia being completely amalgamated into a single long ovate mass, while the third, though clearly distinct from the mass behind it, was separated from it by only less than half its own diameter, very short, stout ribbons uniting the two; it was also of the same size as at 48 hours, and the second ganglion, instead of travelling toward the third, as Newport asserts, retained very nearly or quite its own place, but was reduced in size, being gradually absorbed in place by the cord. This absorption was entirely effected at 55 hours, as also was the complete amalgamation of the third ganglion with the mass behind it. The second ganglion then is not amalgamated with the third, but disappears in place—a point quite in keeping with the lessening importance, but continued integrity, of the prothorax generally.

*Male generative organs.* The testes form a globular mass 1.5 mm. in diameter.

(To be continued on p. 307.)

## XYLOCOPA PERFORATING A COROLLA-TUBE.

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IN October 1881 I noticed a *Xylocopa* perforating the corolla-tube of a salver-shaped flower, somewhat resembling that of a *Petunia*. The bee alighted on the five-lobed spreading top of the flower, which, as the flowers grew, was situated almost perpendicularly to the horizon, and immediately crawled over the edge, between the lobes, so as to reach the outside of the tube, which was somewhat

fluted. Applying its sharp and wedge-shaped maxillae to the grooved surface of the tube, it split this open, three or four millimetres from the base, and continued the split to the base, where the nectar was situated. It then sucked out the nectar quickly, and proceeded to another flower, upon which the operation was repeated.